102(e)
103(a)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 June 2004 (10.06.2004)

PCT

(10) International Publication Number
WO 2004/049413 A1

(51) International Patent Classification[7]: H01L 21/205

(21) International Application Number: PCT/KR2002/002207

(22) International Filing Date: 25 November 2002 (25.11.2002)

(25) Filing Language: Korean

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: IPS LTD. [KR/KR]; 33, Jije-dong, Pyungtaek-city, 450-090 Kyungki-do (KR).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: PARK, Young-Hoon [KR/KR]; 33, Jije-dong, Pyungtaek-city, 450-090 Kyungki-do (KR). HEO, Jin-Pil [KR/KR]; 33, Jije-dong, Pyungtaek-city, 450-090 Kyungki-do (KR). LEE, Heung-Jik [KR/KR]; 33, Jije-dong, Pyungtaek-city, 450-090 Kyungki-do (KR). LEE, Sang-Kyu [KR/KR]; 33, Jije-dong, Pyungtaek-city, 450-090 Kyungki-do (KR). KYUNG, Hyun-Soo [KR/KR]; 33, Jije-dong, Pyungtaek-city, 450-090 Kyungki-do (KR). BAE, Jang-Ho [KR/KR]; 33, Jije-dong, Pyungtaek-city, 450-090 Kyungki-do (KR).

(74) Agent: LEE, Young-Pil; The Cheonghwa Building, 1571-18, Seocho-dong Seocho-gu, 137-874 Seoul (KR).

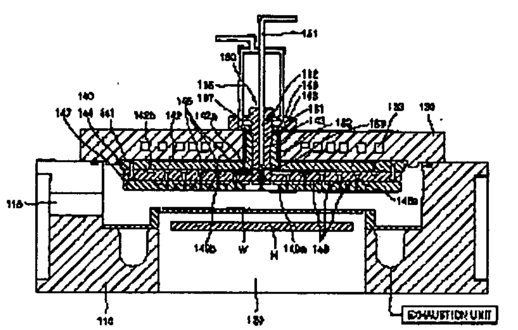
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS FOR DEPOSITING THIN FILM ON WAFER



(57) Abstract: Provided is an apparatus for depositing a thin film on a wafer. The provided apparatus, including a reactor block 110 in which a wafer w is located, a wafer block 120 installed in the reactor block 110 to mount the wafer w, a top plate 130 coupled to cover the reactor block 110, a first supply line 151 for transferring a first reactant gas and/or inert gas supplied to the wafer w, a second supply line 156 for a second reactant gas and/or the inert gas supplied to the wafer w, and a showerhead 140 installed to the top plate 130 while having a plurality of first and second to spray holes 149a and 149b for spraying the gases supplied through the first and second supply fines 151 and 156 toward the wafer w, has the showerhead 140 including first, second, and third diffusion plates 141, 144, and 147, which are successively stacked, wherein the first diffusion plate 141 includes radiation-shaped passages 142 connected to the is second supply line 156 and first distribution holes 142a and 142b communicating with the radiation-shaped passages 142; the second diffusion plate 144 includes a second diffusion region 145 for evenly diffusing the gas supplied through the first distribution holes 142a and 142b and second distribution holes 145a formed on the second diffusion region 145 in uniform intervals; and the third diffusion plate 147 includes a third diffusion region 148 for evenly diffusing the gas supplied through the first supply line 151, first spray holes 149a for spraying the gas supplied through the third diffusion region 148, and second spray holes 149b for spraying the gas supplied through the second distribution holes 145a while the first and second spray holes 149a and 149b are formed in specific intervals.

WO 2004/049413 A1

APPARATUS FOR DEPOSITING THIN FILM ON WAFER

Technical Field

The present invention relates to an apparatus for depositing a thin film on a semiconductor wafer.

Background Art

An apparatus for depositing a thin film on a wafer deposits thin films on the wafer by inputting a plurality of reactant gases into the apparatus. In order to fabricate highly integrated chips, the thin films having high purity and excellent electric characteristics should be deposited on the wafer. Furthermore, since semiconductor manufacturers intend to form micro design rules, it is required to even the thickness of the thin film as well as improving the purity and the electric characteristics of the thin film. To this end, the reactant gases input to the apparatus have to be evenly sprayed onto the wafer. Thus, the studies of improving the structure of the apparatus for depositing the thin film on the wafer have taken place.

Disclosure of the Invention

To solve the above-described problems, it is an objective of the present invention to provide an apparatus for depositing a thin film on a wafer to efficiently deposit the thin film of realizing high purity, excellent electric characteristics, and excellent step coverage on the wafer by using a plurality of reactant gases.

It is another objective of the present invention to provide an apparatus for depositing a thin film on a wafer to improve a heat dissipation efficiency in order to solve the problems due to a high temperature of a showerhead regardless of the high temperature on a wafer block.

To meet the above objectives, according to one aspect of the present invention, there is provided an apparatus for depositing a thin

film on a wafer, including a reactor block 110 in which a wafer w is located, a wafer block 120 installed in the reactor block 110 to mount the wafer w, a top plate 130 coupled to cover the reactor block 110, a first supply line 151 for transferring a first reactant gas and/or inert gas supplied to the wafer w, a second supply line 156 for a second reactant gas and/or the inert gas supplied to the wafer w, and a showerhead 140 installed to the top plate 130 while having a plurality of first and second spray holes 149a and 149b for spraying the gases supplied through the first and second supply lines 151 and 156 toward the wafer w, wherein the showerhead 140 includes first, second, and third diffusion plates 141, 144, and 147, which are successively stacked, wherein the first diffusion plate 141 includes radiation-shaped passages 142 connected to the second supply line 156 and first distribution holes 142a and 142b communicating with the radiation-shaped passages 142; the second diffusion plate 144 includes a second diffusion region 145 for evenly diffusing the gas supplied through the first distribution holes 142a and 142b and second distribution holes 145a formed on the second diffusion region 145 in uniform intervals; and the third diffusion plate 147 includes a third diffusion region 148 for evenly diffusing the gas supplied through the first supply line 151, first spray holes 149a for spraying the gas supplied through the third diffusion region 148, and second spray holes 149b for spraying the gas supplied through the second distribution holes 145a while the first and second spray holes 149a and 149b are formed in specific intervals.

It is preferable that a plurality of plate distribution holes 132 are formed on the top plate 130 to connect the second supply line 156 and the first distribution holes 142a and 142b

It is preferable that the upper surface of the second diffusion plate 144 is irregularly formed, and the second distribution holes 145a are formed on concave portions.

It is preferable that the upper surface of the third diffusion plate 147 is irregularly formed, and the first spray holes 149a are formed on

concave portions and the second spray holes 149b are formed on convex portions.

It is preferable that the apparatus further comprises a first diffuser 163 having a plurality of symmetrically formed holes 163a to evenly mix the first reactant gas and/or the inert gas supplied through the first supply line 151 and spray the gas to the third diffusion region 148.

It is preferable that the apparatus further comprises a second diffuser 168 embedded in a diffusion chamber 167 to evenly mix the second reactant gas and/or the inert gas supplied through the second supply line 156 and supply the gas to the radiation-shaped passages 142, wherein holes 168a are symmetrically formed on the second diffuser 168.

It is preferable that refrigerant passages 133, through which a refrigerant flows, are formed in the top plate 130. Here, the refrigerant passages 133 include an inner refrigerant passage 133a formed on the central portion of the showerhead 140 and an outer refrigerant passage 133b formed to surround the inner refrigerant passage 133a.

Brief Description of the Drawings

FIG. 1 is a sectional view illustrating an apparatus for depositing a thin film on a wafer;

FIGS. 2 and 3 are exploded perspective views illustrating a top plate and a showerhead of FIG. 1, wherein FIG. 2 is a top view and FIG. 3 is a bottom view;

FIGS. 4 and 5 are perspective views illustrating a first diffusion plate of FIG. 1, wherein FIG. 4 is a top view and FIG. 5 is a bottom view;

FIG. 6 and 7 are perspective views illustrating a second diffusion plate of FIG. 1, wherein FIG. 6 is a top view and FIG. 7 is a bottom view;

FIGS. 8 and 9 are perspective views illustrating a third diffusion plate of FIG. 1, wherein FIG. 8 is a top view and FIG. 9 is a bottom view;

FIG. 10 is a perspective view illustrating a reactant gas introducer of FIG. 1;

FIGS. 11 and 12 are perspective views illustrating a second diffuser embedded in the reactant gas introducer of FIG. 10, wherein FIG. 11 is a top view and FIG. 12 is a bottom view; and

FIG. 13 is a plane view illustrating refrigerant passages formed in the top plate of FIG. 1.

Best mode for carrying out the Invention

The present Invention will now be described in more detail with reference to the accompanying drawing.

FIG. 1 is a sectional view illustrating an apparatus for depositing a thin film on a wafer according to the present invention. FIGS. 2 and 3 are exploded perspective views illustrating a top plate and a showerhead of FIG. 1, wherein FIG. 2 is a top view and FIG. 3 is a bottom view.

With reference to FIGS. 1 through 3, the apparatus for depositing the thin film on the wafer includes a reactor block 110, a wafer block 120, a top plate 130, and an exhaustion unit (not shown). Here, a wafer w, which is transferred through a wafer transfer hole 115, is located in the reactor block 110. The wafer block 120 is installed in the reactor block 110, and the wafer w is mounted on the wafer block 120. The top plate 130 is installed to cover the reactor block 110 to separate the reactor block 110 from the outside. The exhaustion unit exhausts gases from the reactor block 110 to the outside.

First and second supply lines 151 and 156 for respectively transferring first and second reactant gases and/or inert gas supplied to the wafer w are assembled on the top of the top plate 130 by a reactant gas introducer 160. A showerhead 140 for spraying the gases supplied from the first and second supply lines 151 and 156 toward the wafer w is installed on the bottom of the top plate 130.

Here, the top plate 130 includes an installation hole 131 so that the showerhead 140 is installed at the bottom of the top plate 130 in the state of being installed in the installation hole 131. A plurality of plate distribution holes 132 connected to radiation-shaped passages 142 on a

first diffusion plate 141, which will be described later, are formed around the installation hole 131.

As shown in FIG. 13, circular refrigerant passages 133 are formed in the top plate 130 to cool the top plate 130 and the showerhead 140. Here, the number of refrigerant passages can be plural, for example, two in the present invention. In this case, the amounts of refrigerants flowing through the refrigerant passages 133a and 133b are controlled to control the cooling degrees of the top plate 130 and the showerhead 140. The refrigerant passages 133 can be divided into the inner refrigerant passage 133a and the outer refrigerant passage 133b. By controlling the amounts of the refrigerants flowing through the refrigerant passages 133a and 133b, the temperature of the showerhead 140 can be maintained uniform even if the temperature of the showerhead 140 at the center is higher than that the temperature at the edges due to the radiant heat generated in the wafer block 120.

The shower head 140 includes a plurality of first spray holes 149a and second spray holes 149b formed on a bottom in uniform intervals, as shown in FIG. 9. In FIG. 9, transparent circles denote the first spray holes 149a and opaque circles denote the second spray holes 149b in order to clearly describe the present invention. The gas supplied through the first supply line 151 is sprayed via the first spray holes 149a and the gas supplied through the second supply line 156 is sprayed via the second spray holes 149b.

When the showerhead 140 is described in detail, the showerhead 140 is formed of first through third diffusion plates 141, 144, and 147, which are successively stacked at the lower portion of the top plate 130.

FIGS. 4 and 5 are perspective views illustrating the first diffusion plate 141 of FIG. 1, wherein FIG. 4 is a top view and FIG. 5 is a bottom view.

Referring to FIGS. 4 and 5, the first diffusion plate 141 includes the radiation-shaped passages 142 connected to the second supply line 156 and first distribution holes connected with the radiation-shaped

passages 142. Here, the first distribution holes are divided into inner first distribution holes 142a formed at the central portion of the radiation-shaped passages 142 and outer first distribution holes 142b formed at the edge portions of the radiation-shape passages 142.

In addition, an installation pipe 143 is formed at the center of the first diffusion plate 141. Here, the installation pipe 143 is coupled to the installation hole 131 when the second and third diffusion plates 144 and 147 are assembled with the first diffusion plate 141 so that the showerhead 140 is installed to the top plate 130.

FIGS. 6 and 7 are perspective views illustrating the second diffusion plate 144 of FIG. 1, wherein FIG. 6 is a top view and FIG. 7 is a bottom view.

Referring to FIGS. 6 and 7, the second diffusion plate 144 includes a second diffusion region 145 for evenly diffusing the gas supplied through the inner and outer first distribution holes 142a and 142b, and second distribution holes 145a, which are formed on the second diffusion region 145 in uniform intervals. Here, the second diffusion region 145 is formed due to irregularities on the upper surface of the second diffusion plate 144. The second distribution holes 145a are formed on the concave portions in uniform intervals.

FIGS. 8 and 9 are perspective views illustrating the third diffusion plate 147 of FIG. 1, wherein FIG. 8 is a top view and FIG. 9 is a bottom view.

Referring to FIGS. 8 and 9, the third diffusion plate 147 has a third diffusion region 148 for evenly diffusing the gas supplied through the first supply line 151. Here, the third diffusion region 148 is formed due to the irregularities on the upper surface of the third diffusion plate 147.

The first spray holes 149a are formed on the concave portions of the third diffusion plate 147 and the second spray holes 149b are formed on the convex portions. The first through third diffusion plates 141, 144, and 147 are stacked so that the gas supplied through the first supply line 151 is sprayed via the first spray holes 149a and the gas supplied

through the second supply line 156 is sprayed via the second spray holes 149b.

The first through third diffusion plates 141, 144, and 147 are firmly attached to the bottom of the top plate 130 using screws, wherein the irregular upper surfaces of the second and third diffusion plates 144 and 147 are attached to the bottoms of the first diffusion plate 141 and the second diffusion plate 144, respectively. In this case, the second distribution holes 145a on the second diffusion plate 144 communicate with the second spray holes 149b on the third diffusion plate 147.

FIG. 10 is a perspective view illustrating the reactant gas introducer 160 of FIG. 1. FIGS. 11 and 12 are perspective views illustrating a second diffuser 168 embedded in the reactant gas introducer 160 of FIG. 10, wherein FIG. 11 is a top view and FIG. 12 is a bottom view.

As shown in FIGS. 1, 2, and 10, the reactant gas introducer 160 is attached to the top of the top plate 130 in the state of being closely inserted into the installation pipe 143 of the first diffusion plate 141. The reactant gas introducer 160 is formed of a gas introduction tube 161, which is coupled to the inside of the installation pipe 143, and a diffusion chamber cap 166, which is attached to the top of the top plate 130. Here, O-rings are installed between the gas introduction tube 161 and the installation pipe 143, and between the diffusion chamber cap 166 and the top plate 130 to seal the gaps between the components.

A through hole 162 is formed in the gas introduction tube 161.

A ring-shaped diffusion chamber 167 is formed in the diffusion chamber cap 166.

The first supply line 151 is coupled to the gas introduction tube 161. A first diffuser 163 for evenly mixing the first reactant gas and/or the inert gas and spraying the gas is arranged at the end of the gas introduction tube 161. A plurality of holes 163a are symmetrically formed on the first diffuser 163. Here, the holes 163a are formed at the central portion of the third diffusion region 148 on the third diffusion plate

147. In the present invention, four holes 163a are arranged.

The second supply line 156 is coupled to the diffusion chamber cap 166. A second diffuser 168 for evenly mixing the second reactant gas and/or the inert gas and supplying the gas to the radiation-shaped passages 142 via the plate distribution holes 132 is installed in the diffusion chamber 167, which is formed in the diffusion chamber cap 166. A plurality of holes 168a are symmetrically formed on a ring-shaped member to form the second diffuser 168.

In a conventional showerhead, a large circular diffusion region is formed to efficiently diffuse the second reactant gas; however, such a structure cannot maintain a pertinent temperature of the showerhead by using the heat transfer efficiency of the showerhead when performing a chemical vapor deposition (CVD) or an atomic layer deposition (ALD) process at a high temperature.

In the present invention, even when the temperature of the wafer block 120 is higher than 550°C, the irregularities on the first through third diffusion plates 141, 144, and 147 efficiently conduct the radiant heat of the wafer block 120 toward the top plate 130. Accordingly, the showerhead 140 is prevented from being bent or corroded due to high temperature, and the reaction of the showerhead 140 with the process gas is minimized to minimize the generation of particles.

In addition, the refrigerant passages 133 formed in the top plate 130 also control the temperature of the showerhead 140. Here, if the pertinent temperature of the showerhead 140 cannot be maintained using the heat transfer efficiency of the showerhead 140 to the top plate 130 alone due to the process temperature, a refrigerant, such as water, oil, or air, flows through the refrigerant passages 133. Accordingly, the pertinent temperature of the first through third diffusion plates 141, 144, and 147 of the showerhead 140 is maintained. The reason for dividing the refrigerant passages 133 into the inner refrigerant passage 133a and the outer refrigerant passage 133b is described above.

Hereafter, the operation of the apparatus for depositing the thin

film on the wafer will now be described.

The wafer w transferred through the wafer transfer hole 115 is mounted on the wafer block 120.

Thereafter, when the wafer w is heated at a predetermined temperature, the first reactant gas and/or the inert gas is supplied to the third diffusion region 148 of the third diffusion plate 147 by passing the first supply line 151, the through hole 162, the first diffuser 163, and the holes 163a. The first reactant gas and/or the inert gas supplied to the third diffusion region 148 is sufficiently diffused on the third diffusion region 148 and sprayed to the wafer w via the first spray holes 149a.

On the other hand, the second reactant gas and/or the inert gas is supplied to the radiation-shaped passages 142 of the first diffusion plate 141 by passing the second supply line 156, the diffusion chamber 167 of the reactant gas introducer 160, the holes 168a of the second diffuser 168, and the plate distribution holes 132. Thereafter, the second reactant gas and/or the inert gas is supplied to the second diffusion region 145 of the second diffusion plate 144 via the first distribution holes 142a and 142b of the radiation-shaped passages 142 and diffused on the second diffusion region 145. The second reactant gas and/or the inert gas is sprayed to the wafer w via the second spray holes 149b after passing through the second distribution holes 145a.

As described above, the first and second reactant gases and/or the inert gas forms the thin film on the wafer w, and reactants and the gases not used in the process are transferred to the exhaustion unit via an exhaustion hole.

The drawing and specification of the invention are provided for illustration only and are not used to limit the scope of the invention set forth in appended claims.

Industrial Applicability

As described above, a thin film having high purity, excellent electric characteristics, and excellent step coverage can be efficiently

deposited on a wafer using a plurality of reactant gases. In addition, a CVD process and an ALD process can be performed at a high temperature.

What is claimed is:

1. An apparatus for depositing a thin film on a wafer, including a reactor block 110 in which a wafer w is located, a wafer block 120 installed in the reactor block 110 to mount the wafer w, a top plate 130 coupled to cover the reactor block 110, a first supply line 151 for transferring a first reactant gas and/or inert gas supplied to the wafer w, a second supply line 156 for a second reactant gas and/or the inert gas supplied to the wafer w, and a showerhead 140 installed to the top plate 130 while having a plurality of first and second spray holes 149a and 149b for spraying the gases supplied through the first and second supply lines 151 and 156 toward the wafer w, wherein the showerhead 140 includes first, second, and third diffusion plates 141, 144, and 147, which are successively stacked,

wherein the first diffusion plate 141 includes radiation-shaped passages 142 connected to the second supply line 156 and first distribution holes 142a and 142b communicating with the radiation-shaped passages 142;

the second diffusion plate 144 includes a second diffusion region 145 for evenly diffusing the gas supplied through the first distribution holes 142a and 142b and second distribution holes 145a formed on the second diffusion region 145 in uniform intervals; and

the third diffusion plate 147 includes a third diffusion region 148 for evenly diffusing the gas supplied through the first supply line 151, first spray holes 149a for spraying the gas supplied through the third diffusion region 148, and second spray holes 149b for spraying the gas supplied through the second distribution holes 145a while the first and second spray holes 149a and 149b are formed in specific intervals.

2. The apparatus of claim 1, wherein a plurality of plate distribution holes 132 are formed on the top plate 130 to connect the second supply line 156 and the first distribution holes 142a and 142b

3. The apparatus of claim 1, wherein the upper surface of the second diffusion plate 144 is irregularly formed, and the second distribution holes 145a are formed on concave portions.

4. The apparatus of claim 1, wherein the upper surface of the third diffusion plate 147 is irregularly formed, and the first spray holes 149a are formed on concave portions and the second spray holes 149b are formed on convex portions.

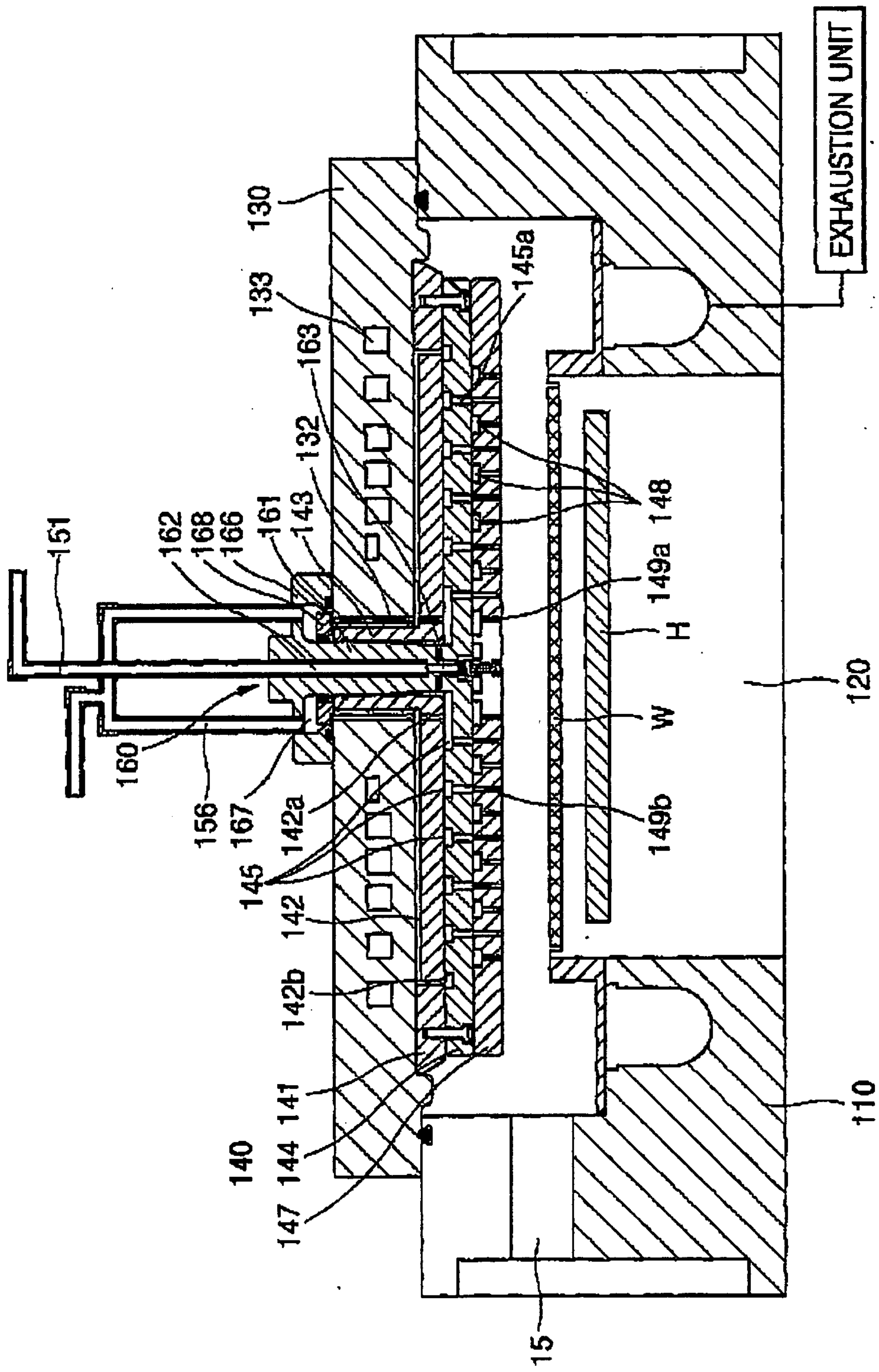
5. The apparatus of claim 1, further comprising a first diffuser 163 having a plurality of symmetrically formed holes 163a to evenly mix the first reactant gas and/or the inert gas supplied through the first supply line 151 and spray the gas to the third diffusion region 148.

6. The apparatus of claim 1, further comprising a second diffuser 168 embedded in a diffusion chamber 167 to evenly mix the second reactant gas and/or the inert gas supplied through the second supply line 156 and supply the gas to the radiation-shaped passages 142, wherein holes 168a are symmetrically formed on the second diffuser 168.

7. The apparatus of claim 1, wherein refrigerant passages 133, through which a refrigerant flows, are formed in the top plate 130.

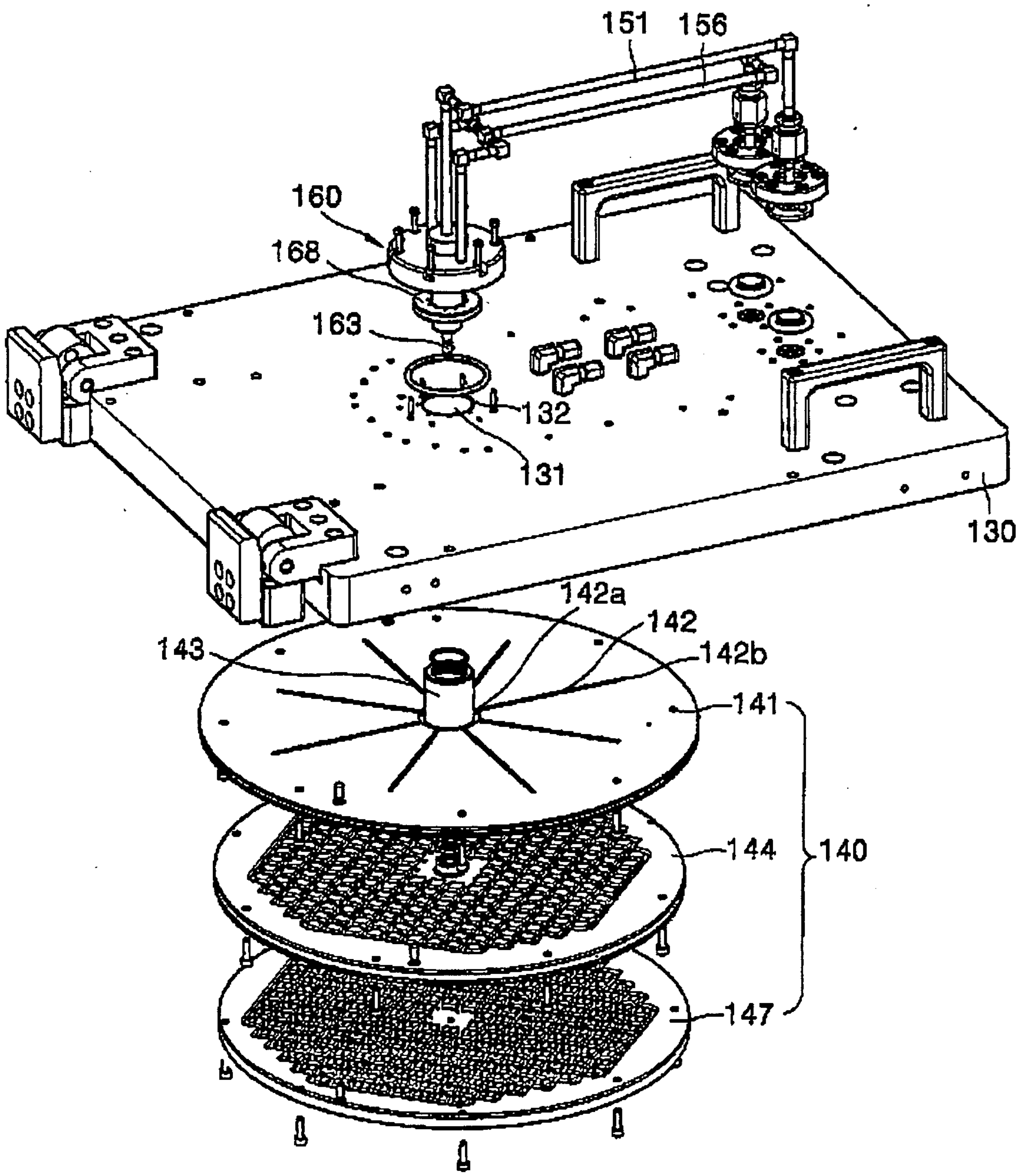
8. The apparatus of claim 1, wherein the refrigerant passages 133 include an inner refrigerant passage 133a formed on the central portion of the showerhead 140 and an outer refrigerant passage 133b formed to surround the inner refrigerant passage 133a.

FIG. 1


EXHAUSTION UNIT
130
133
145a
163
132
148
149a
H
120
W
151
162
168
166
161
143
160
156
167
142a
149b
145
142
142b
141
144
140
147
110
115

2/13

FIG. 2


151
156
160
168
163
132
131
130
142a
142
143
142b
141
144
140
147

3/13

FIG. 3

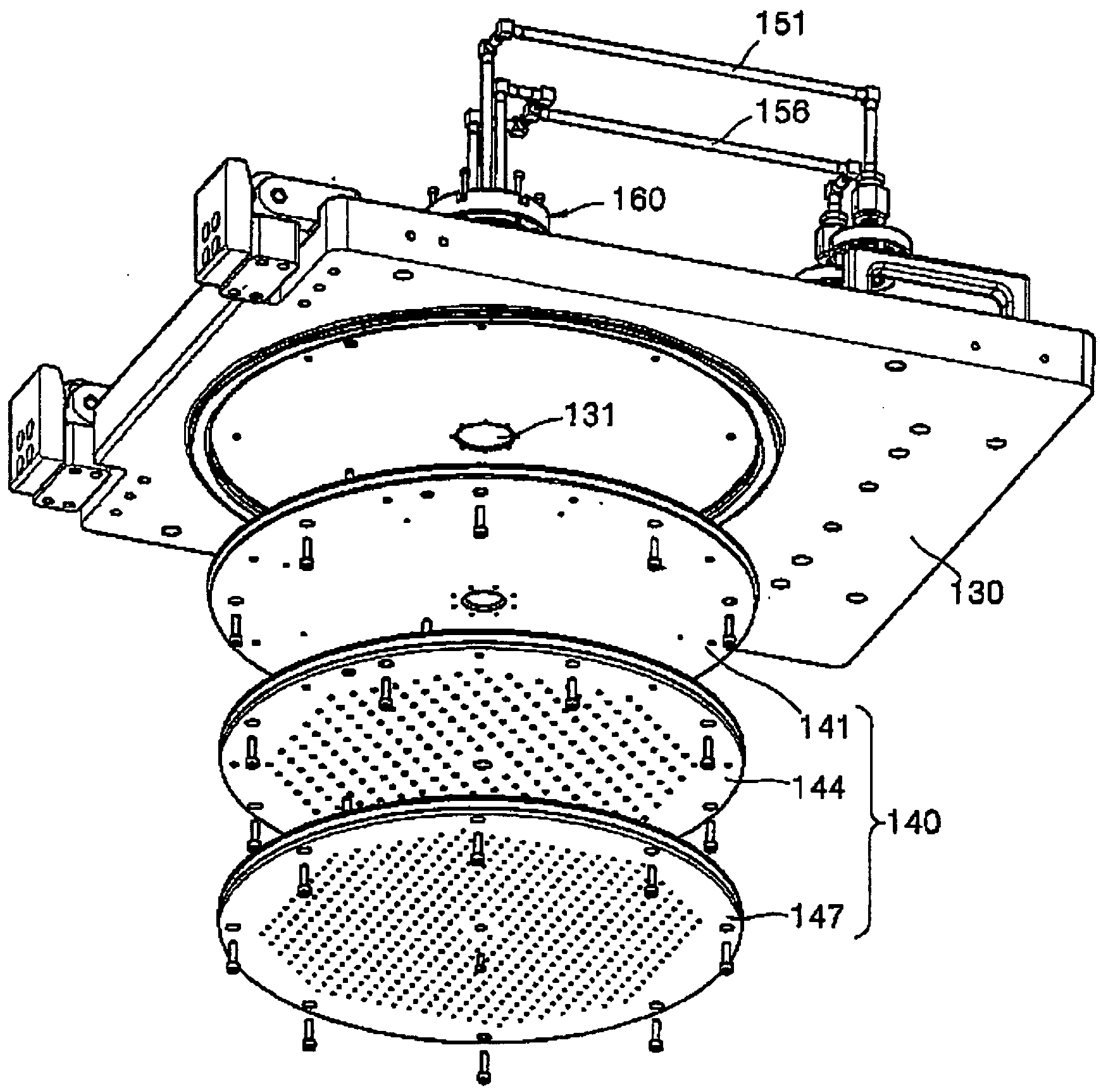


FIG. 4

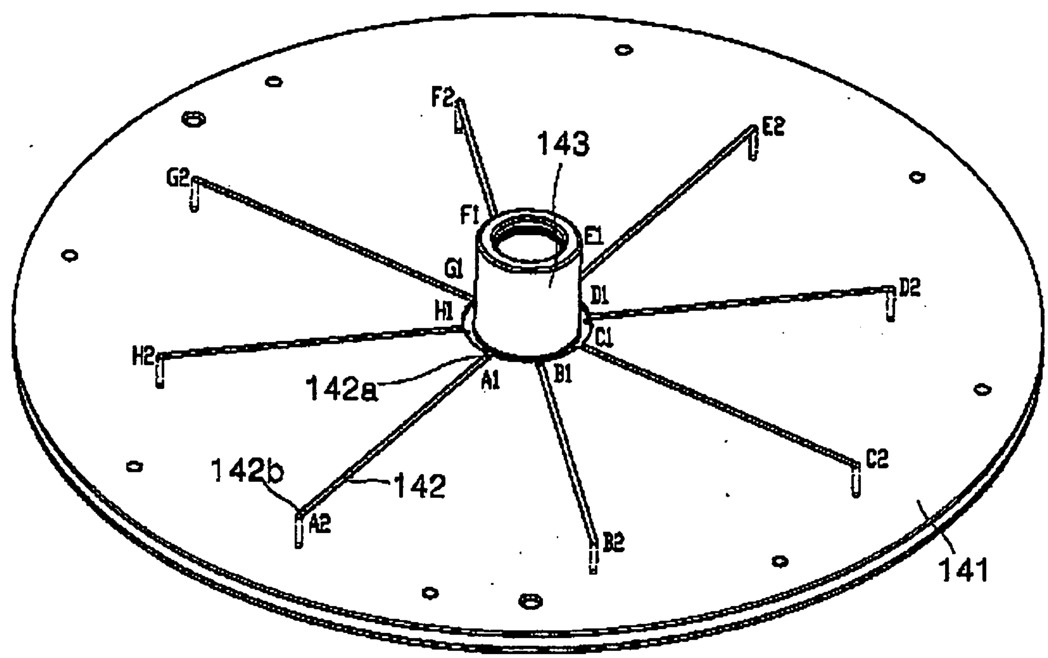


FIG. 5

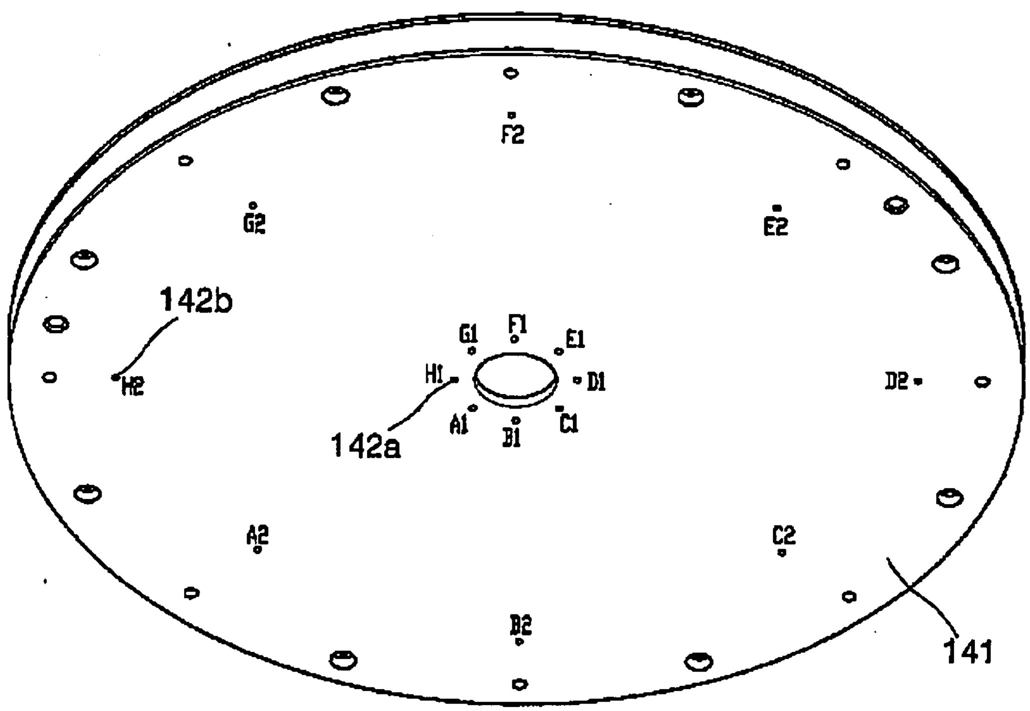


FIG. 6

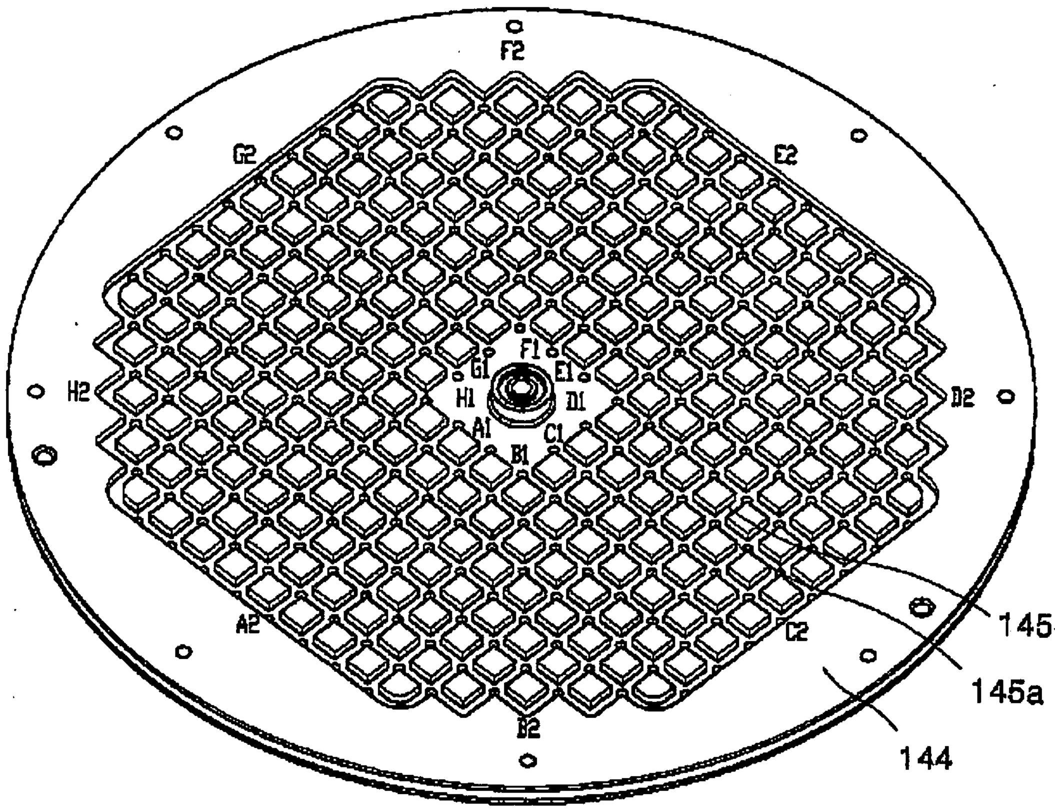


FIG. 7

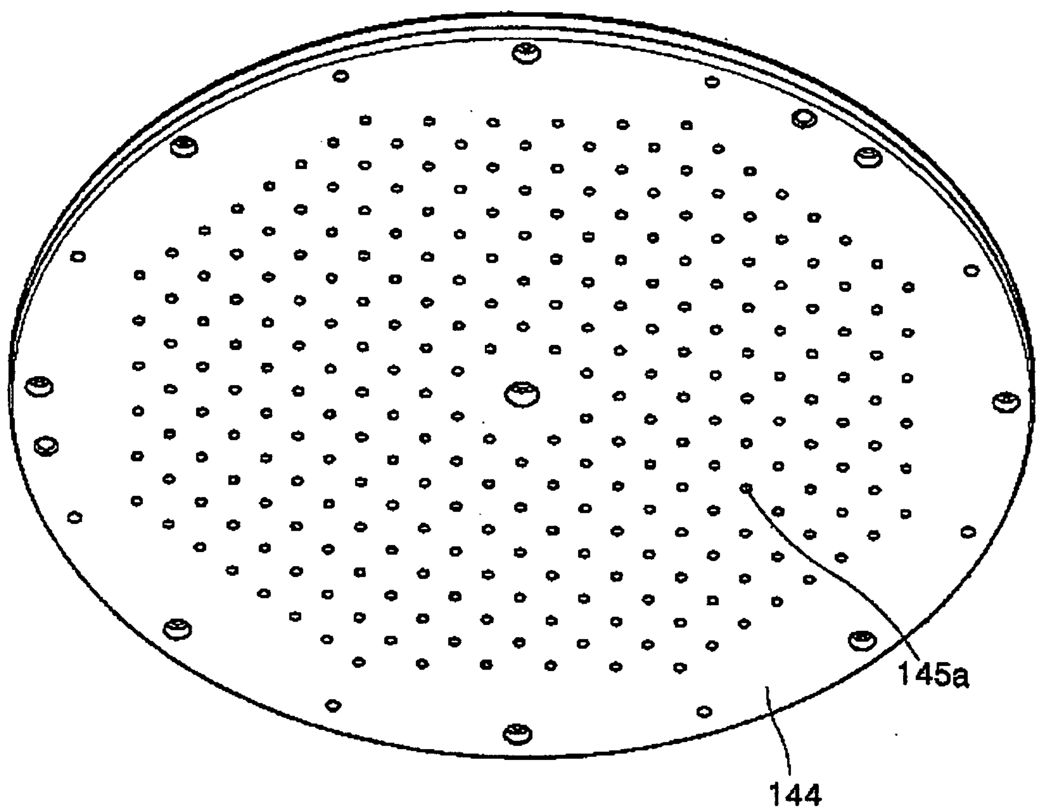


FIG. 8

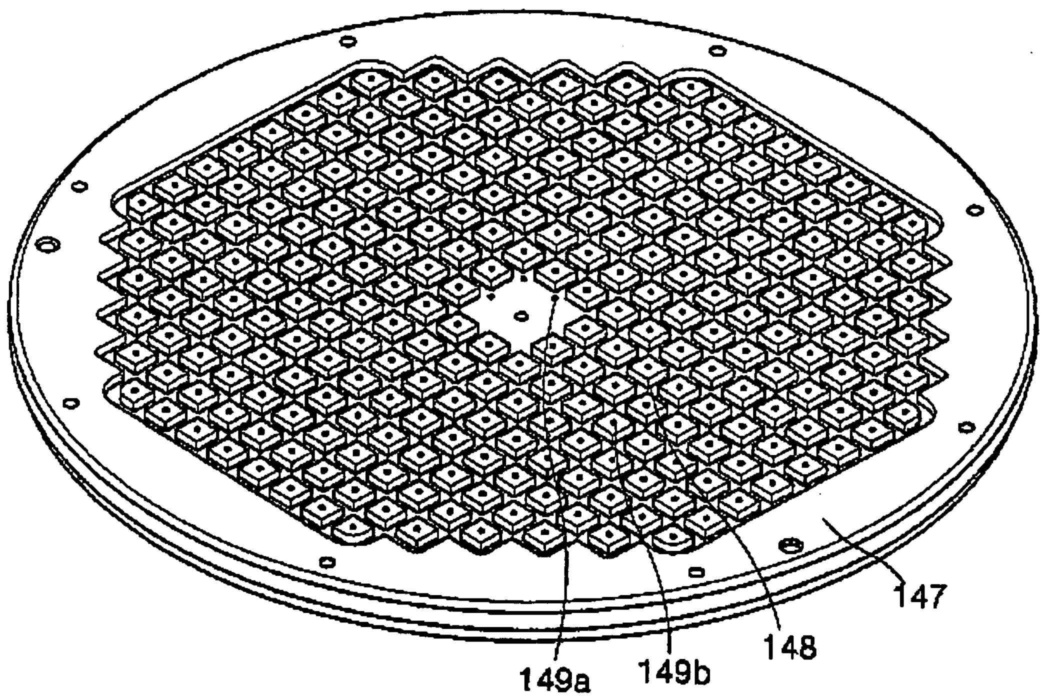


FIG. 9

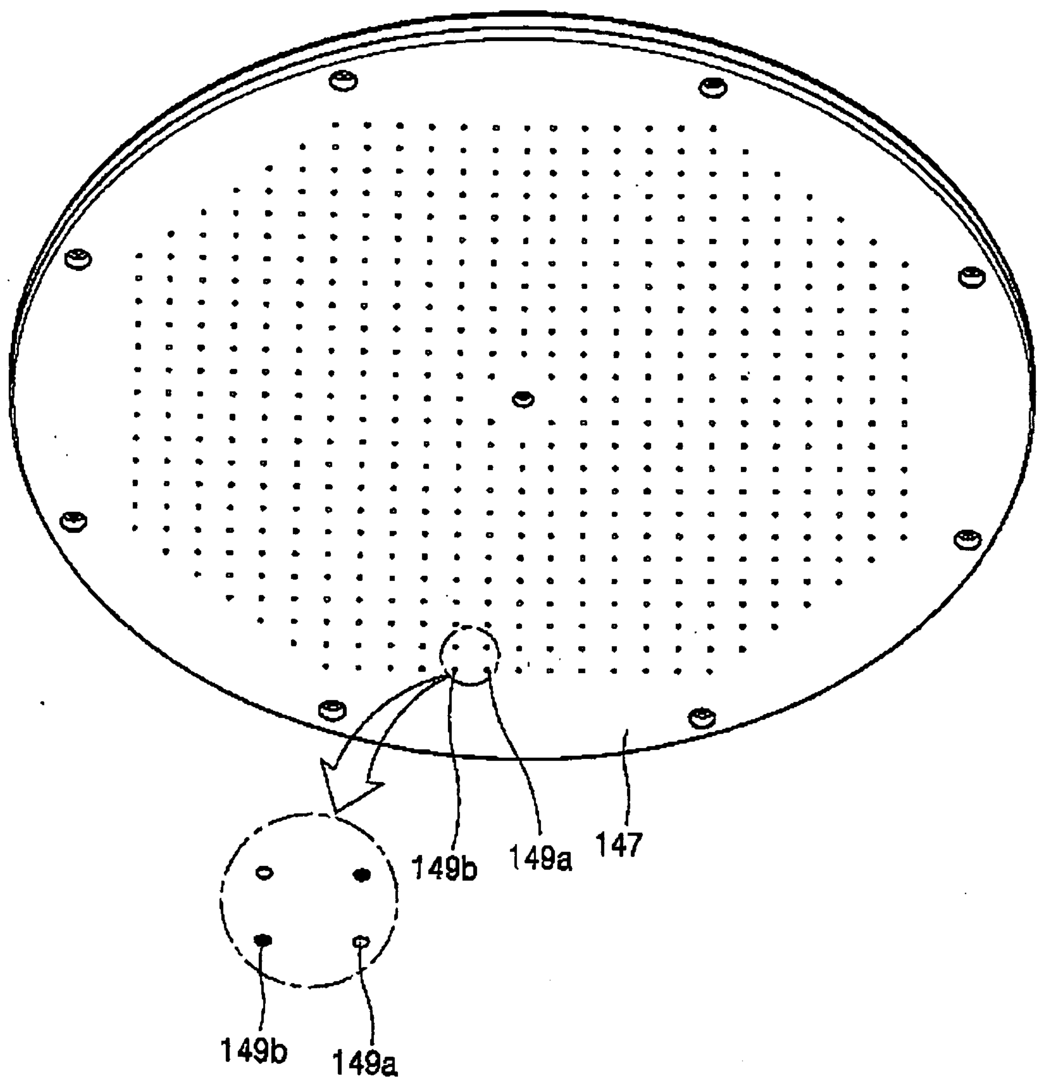


FIG. 10

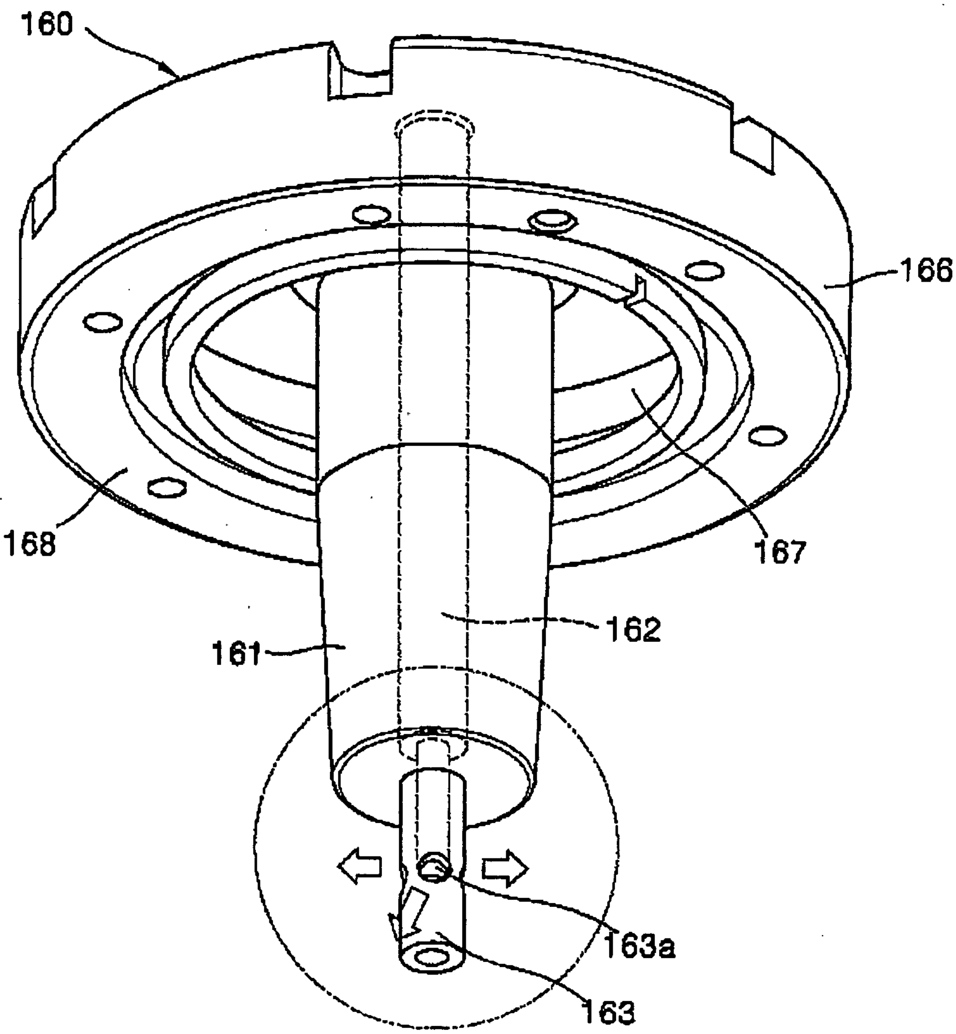


FIG. 11

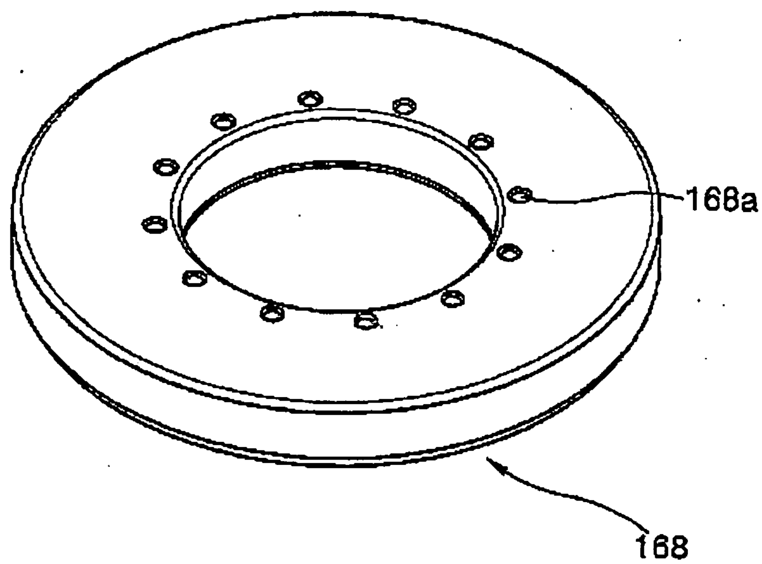


FIG. 12

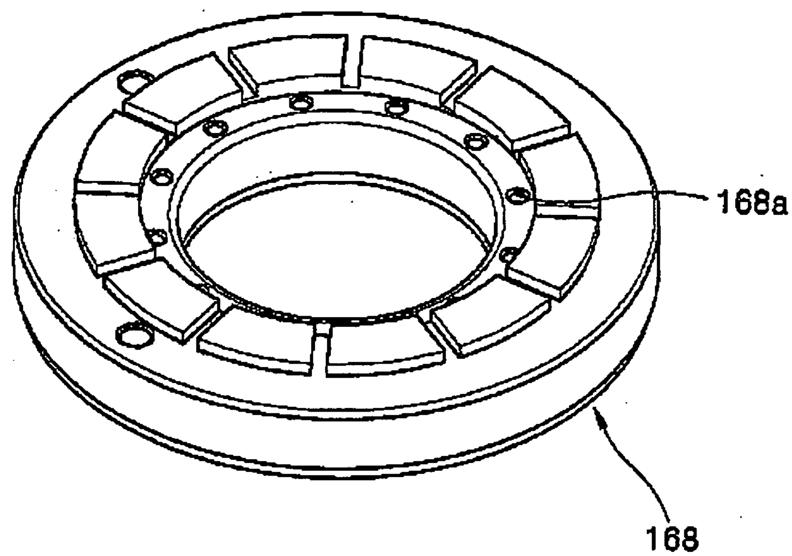
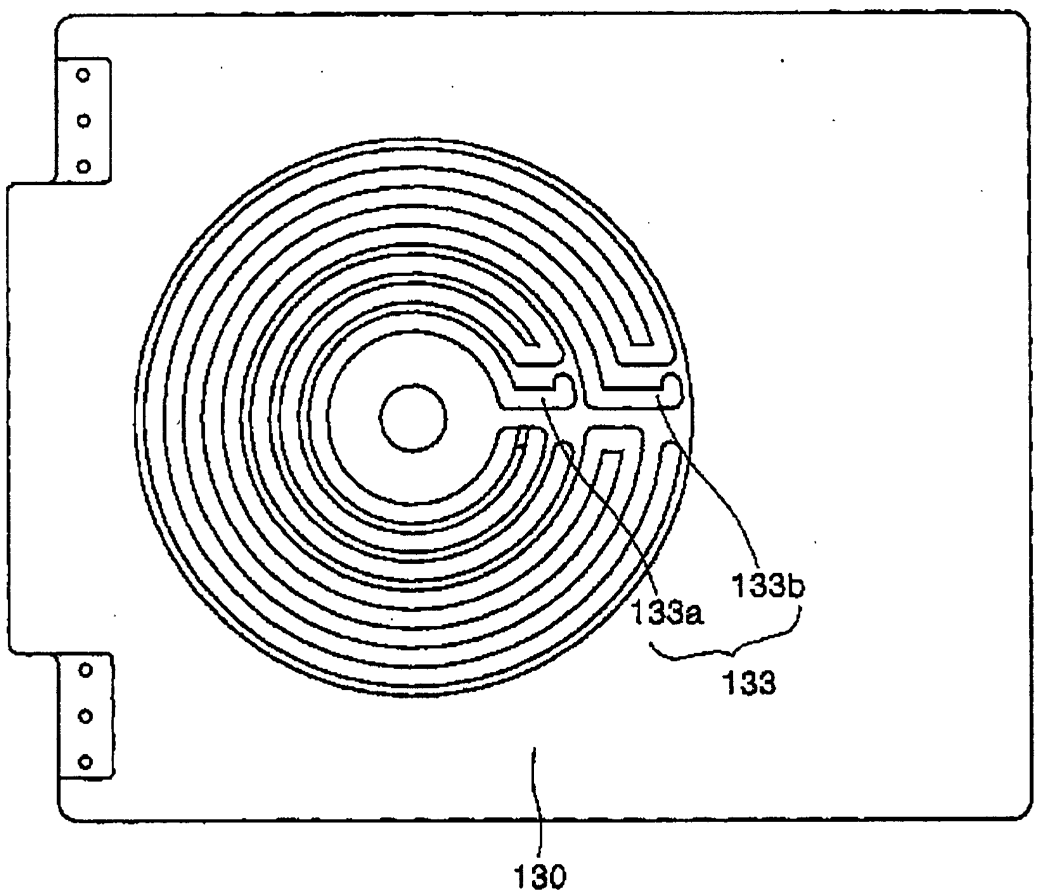


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR02/02207

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H01L 21/205

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 H01L21, C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KOREAN PATENTS AND APPLICATIONS FOR INVENTIONS SINCE 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

KIPONET, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR02-56763A(HYUNDAI SEMICONDUCTOR CORP.) 15 SEPTEMBER 2000 SEE THE WHOLE DOCUMENT	1
A	KR00-54969A(PK CO., LTD.) 05 SEPTEMBER 2000 SEE THE WHOLE DOCUMENT	1
PA	JP14-141290A(HITACHI LTD, HITACHI KOKUSAI ELECTRIC INC.) 15 MAY 2002 SEE THE ABSTRACT AND FIGURE 1	1
A	EP 0591082A3(INTERNATIONAL BUSSINESS MACHINES CORP.) 29 JANUARY 1997 SEE THE ABSTRACT	1

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 MARCH 2003 (17.03.2003)	18 MARCH 2003 (18.03.2003)

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea	LEE, Son Taek
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5980

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR02/02207

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 00-56763A	15.09.2000	NONE	
KR 00-54969A	05.09.2000	NONE	
JP14-141290A	17.05.2002	NONE	
EP0591082A3	29.01.1997	US5290358BA JP2739921B2	01.03.1994 15.04.1998